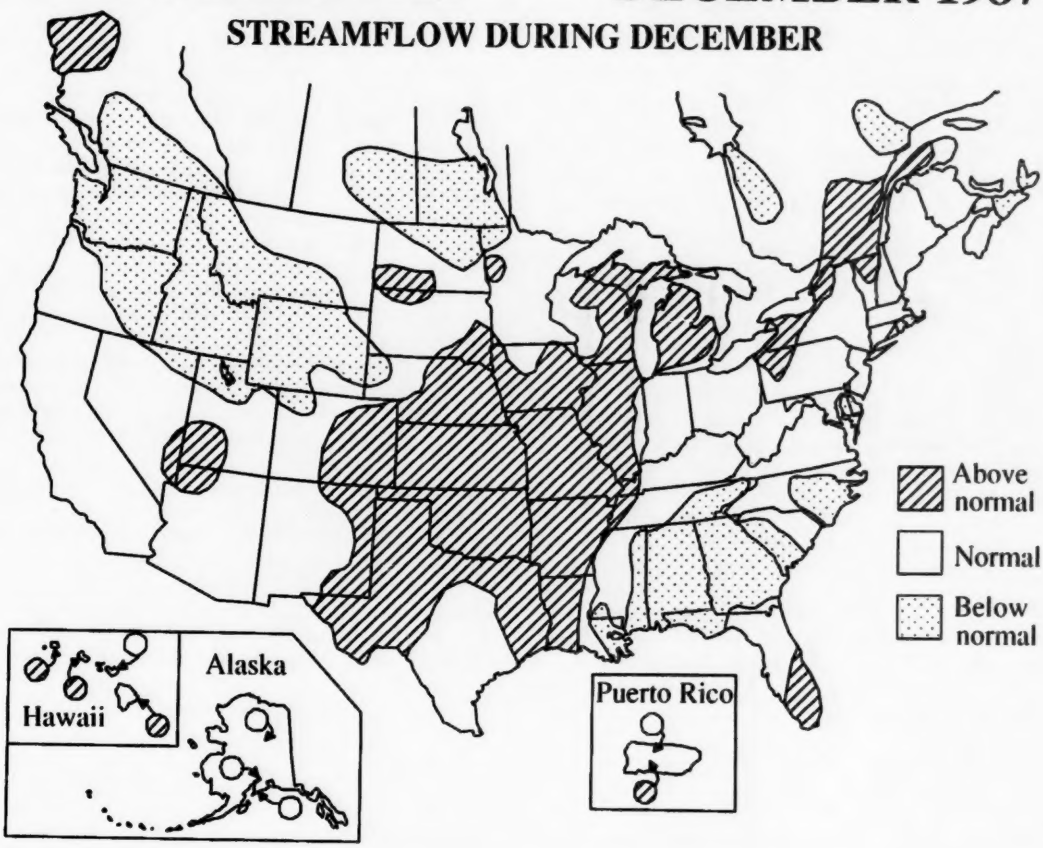
National Water Conditions

UNITED STATES
Department of the Interior
Geological Survey

CANADA
Department of the Environment
Water Resources Branch

DECEMBER 1987

STREAMFLOW DURING DECEMBER



Heavy rains totalling up to 15 inches December 24-27 caused flooding in northeastern Arkansas and western Tennessee.

In Hawaii, a week of thunderstorms and high winds which began December 11 and a New Year's Eve storm caused flooding.

Streamflow was in the normal to above-normal range at 75 percent of the 191 reporting index stations in southern Canada, the United States, and Puerto Rico, compared with the 73 percent in those ranges for last month. Total December flow was the lowest for December in the last 6 years. There were no December lows, but new December highs occurred at three index stations: one each in Oklahoma, Florida, and Puerto Rico.

Mean December elevations at the four master gages on the Great Lakes (provisional National Ocean Service data) declined from last month at two gages and increased from last month at the other two gages.

The level of Utah's Great Salt Lake declined to a seasonal low of 4,209.35 feet above National Geodetic Vertical Datum (NGVD) of 1929 on December 20, then rose to 4,209.40 by December 31.

Contents of 75 percent of reporting reservoirs were near or above average for the end of December, compared with 70 percent for the end of November.

The combined flow of the 3 largest rivers in the lower 48 States--Mississippi, St. Lawrence, and Columbia--was in the normal range during December after increasing about 43 percent from November to December.

For calendar year 1987, streamflow was in the normal to below-normal range in much of the United States and southern Canada. About 87 percent of the 191 sites reporting for 1987 had flows in the normal to below-normal range compared with about 68 percent in those ranges for calendar year 1986.

SURFACE-WATER CONDITIONS DURING DECEMBER 1987

Heavy rains totalling up to 15 inches December 24-27 caused flooding in northeastern Arkansas and western Tennessee. The most severe flooding took place on ungaged streams but peak discharge at three gaging stations, two in Arkansas and one in Tennessee, exceeded both the 50-year flood and the previous flood of record. In Arkansas, the L'Anguile River near Colt (drainage area 535 square miles) peaked at 15,500 cubic feet per second (cfs), recurrence interval 55 years, and 17.34 feet on December 28; about 3,500 cfs more and 1.53 feet higher than the previous maximum (12,000 cfs and 15.81 feet on December 9, 1978): Bayou Meto near Lonoke (drainage area 207 square miles) peaked at 5,670 cfs (a discharge about 90 cfs greater than that for the 100-year flood) and 27.09 feet; about 970 cfs more and 0.54 foot higher than the previous maximum (4,700 cfs and 26.55 feet on May 18, 1968). In Tennessee, the Loosahatchie River near Arlington (drainage area 262 square miles) peaked at 27,400 cfs (recurrence interval 50 years) and 25.27 feet on December 25: about 3,700 cfs more and 0.31 foot higher than the previous maximum (23,700 cfs and 24.96 feet on March 13, 1975).

In Hawaii, a week of thunderstorms and high winds which began December 11 caused flooding in low-lying areas, agricultural damages, and power outages. At the end of the month, heavy rains (13-18 inches) on December 31, 1987 - January 1, 1988, caused flooding on eastern Oahu, and, to a lesser extent, at Hilo on the island of Hawaii. No data on peak discharges or damage estimates were available.

Flows generally decreased from November to December in eight States and also most of southern Canada: seasonally in Alaska, British Columbia, Alberta, Montana, North Dakota, Wyoming, Utah, Colorado, Ontario and Quebec; variably in Minnesota; and contraseasonally in Saskatchewan, Vermont, and Nova Scotia. Flows changed contraseasonally in Hawaii, and variably in Idaho, California, Arizona, Iowa, Mississippi, Florida, and Puerto Rico. Streamflow generally increased in the rest of southern Canada and the United States: variably in New Mexico, Texas, Nebraska, Missouri, Wisconsin, Maryland, New Jersey, Maine, and New Brunswick; contraseasonally in South Dakota, Kansas, Oklahoma, and New Hampshire; and seasonally in all other areas.

Streamflow was in the normal to above-normal range at 75 percent of the 191 reporting index stations in southern Canada, the United States, and Puerto Rico, compared with the 73 percent in those ranges for last month. This is the lowest percentage of stations with flow in the normal to above-normal range for December in the last 6 years. Total December flow of 1,558,950 cfs (for the 163 index stations in the conterminous United States and southern Canada) was 2.2 percent above median and 61 percent above last month's total, but was the lowest for December in the last 6 years: about 458,600 cfs or 23 percent below that of December 1984, the second lowest December during the period.

There were no December lows, but new December highs occurred at three index stations (see table on page 4): one each in Oklahoma, Florida, and Puerto Rico. Hydrographs of streamflow at eight index stations, including those at which new December extremes occurred, are on page 5. Three of the hydrographs on the left are for the sites at which new maximums occurred and the fourth is for a site where flows are currently above normal. (Note that the hydrograph for Washita River near Dickson, Oklahoma, is truncated at 1 cfs because the graph would have been compressed beyond readability--the minimum of record for September is 0.1 cfs.) The hydrographs on the right are for two sites at which flows are currently below normal and two sites at which flows are currently normal.

Mean December elevations at the four master gages on the Great Lakes (provisional National Ocean Service data) declined from last month at two gages and increased from last month at the other two gages: Lake Superior declined 0.10 foot, and was in the normal range for the ninth consecutive month; Lake Huron declined 0.08 foot, and was in the normal range for the fifth consecutive month; Lake Erie rose 0.02 foot, and was in the above-normal range for the 43rd consecutive month (since June 1984); Lake Ontario rose 0.34 foot, and was in the normal range for the second month, after 2 months in the below-normal range. Levels ranged from 0.98 foot (Lake Superior) to 1.91 feet (Lake Huron) lower than those for December 1986. Stage hydrographs at the master gages for Lakes Superior, Huron, Erie, and Ontario are on page 6.

(Continued on page 4.)

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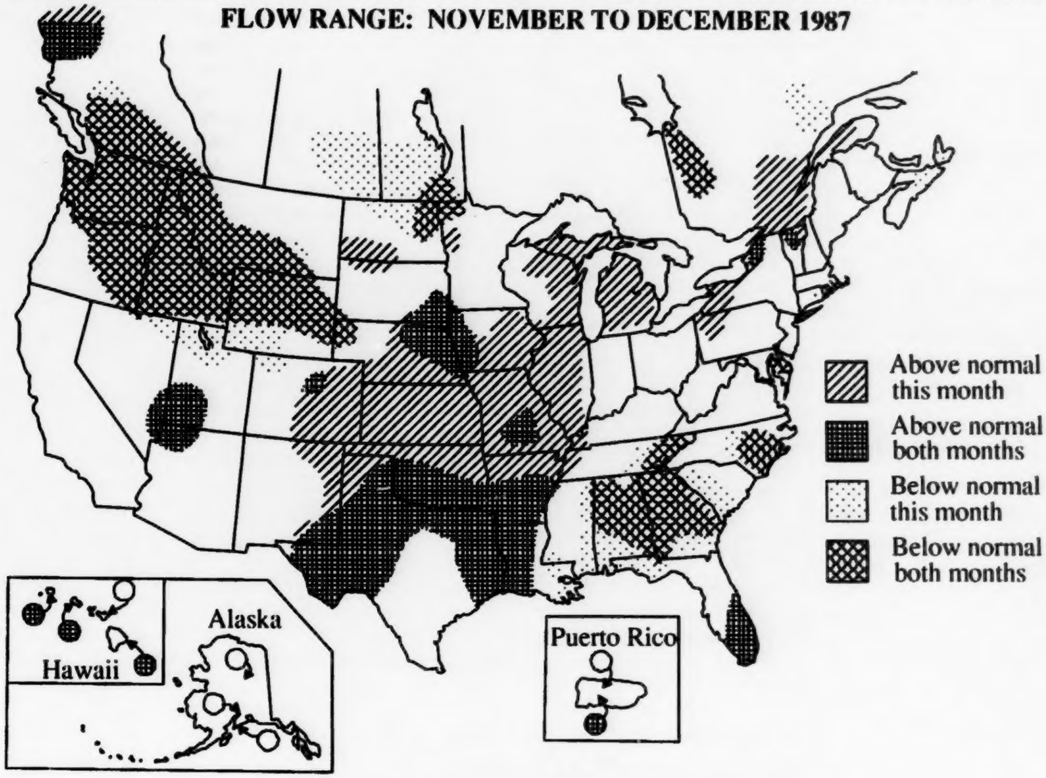
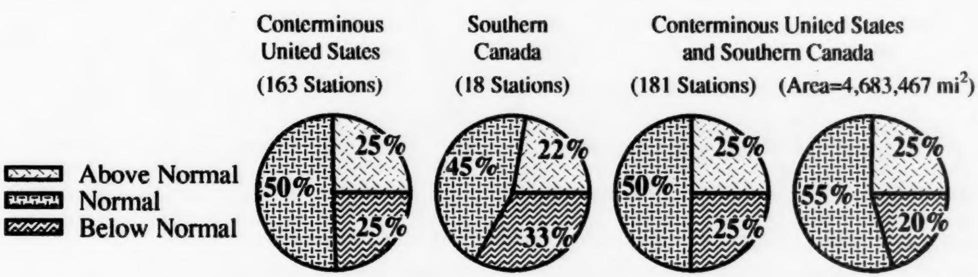
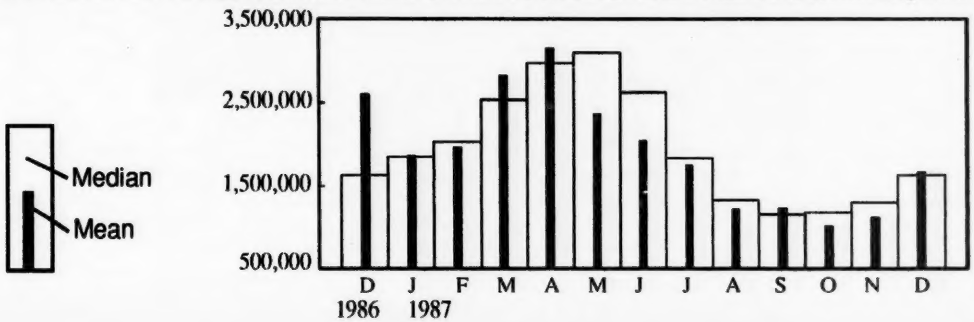
PERSISTENCE IN, OR MOVEMENT INTO, THE BELOW-NORMAL OR ABOVE-NORMAL FLOW RANGE: NOVEMBER TO DECEMBER 1987



SUMMARY OF DECEMBER 1987 STREAMFLOW FLOW RANGES



COMPARISON OF TOTAL MONTHLY MEANS WITH TOTAL MONTHLY MEDIANS (Cubic Feet per Second)



NEW MAXIMUMS DURING DECEMBER 1987 AT STREAMFLOW INDEX STATIONS

Station number	Stream and place of determination	Drainage area (square miles)	Years of record	Previous December maximums (period of record): Monthly mean in cfs (year)	Previous December maximums (period of record): Daily mean in cfs (year)	December 1987: Monthly mean in cfs	December 1987: Percent of median	December 1987: Daily mean in cfs	December 1987: Day
02232500	St. Johns River near Christmas, Fla.	1,539	54	3,383 (1969)	4,580 (1969)	4,375	430	---	--
07331000	Washita River near Dickson, Okla.	7,202	59	4,150 (1946)	30,800 (1946)	4,920	1,370	20,700	25
50112500	Rio Inabon at Real Abajo, Puerto Rico	9.70	21	26.6 (1965)	126 (1965)	49.0	422	80.0	12

The level of Utah's Great Salt Lake (see graph on page 6) declined to a seasonal low of 4,209.35 feet above National Geodetic Vertical Datum (NGVD) of 1929 on December 20, then rose to 4,209.40 by December 31. The monthend level is 1.80 feet lower than that of December 31, 1986, when the lake was already 3 1/2 months into the seasonal rise, but is still the second highest recorded for the end of December.

Contents of 75 percent of reporting reservoirs were near or above average for the end of December, compared with 70 percent for the end of November. Most reporting reservoirs in Vermont, Massachusetts, New Jersey, Pennsylvania, Georgia, Alabama, Wisconsin, Oklahoma, Texas, New Mexico, Arizona, and Colorado had contents that were more than 5 percent of normal maximum contents above the average for the end of December. In contrast, most reporting reservoirs in Quebec, North Carolina, Montana, Idaho, Washington, California, and Nevada had contents that were more than 5 percent of normal maximum contents below the average for the end of December. However, only four reservoirs or reservoir systems had both a decline of more than 5 percent of normal maximum contents during the month and monthend contents more than 5 percent of normal maximum contents below monthend averages: Coeur d'Alene Lake, Idaho; Ross, Lake Chelan, and Franklin D. Roosevelt Lake, all in Washington. The Hiwassee Projects (Tennessee Valley), Wisconsin River system (Wisconsin), four of the five reservoirs in Oklahoma (all except Lake Altus), and Lake Travis (Texas) had both an increase of more than 5 percent of normal maximum contents during the month and monthend contents that were more than 5 percent of normal maximum contents above monthend averages. Graphs of contents for seven reservoirs are shown on page 10 with contents for the 99 reporting reservoirs given on page 11.

The combined flow of the 3 largest rivers in the lower 48 States--Mississippi, St. Lawrence, and Columbia--averaged a normal 804,600 cfs (about 4 percent below median) during December after increasing about 43 percent from November to December. This month's combined flow was the lowest for December in the last 6 years--about 26 percent lower than that for December 1984, the second lowest combined December flow during the period 1982-87. Mean flow of the St. Lawrence River at Cornwall, Ontario, increased by about 8 percent from that for November and was in the above-normal range after being in the normal range last month. Mean flow of the Mississippi River at Vicksburg, Mississippi, increased by about 83 percent from that for November, and was in the normal range for the second month. Mean flow of the Columbia River at The Dalles, Oregon, was in the below-normal range for the seventh consecutive month after increasing by about 14 percent from November to December. Flow hydrographs for both the combined and individual flows of the "Big 3" are shown on page 8. Dissolved solids and water temperatures at five large river stations are given on page 8. December flows of the "Big 3" and other large rivers are given in the Flow of Large Rivers table on page 9.

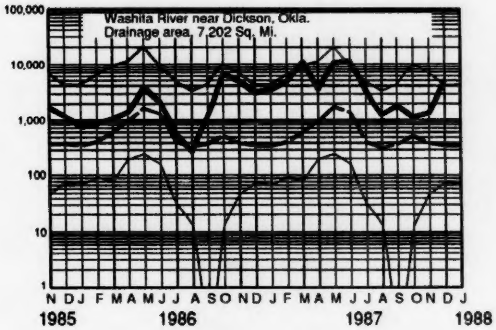
Record-high December precipitation (amounts in inches) occurred at six cities: Honolulu, Hawaii (17.28); Valentine, Nebraska (2.04); Abilene (4.65) and El Paso (2.87), Texas; Madison (4.09) and Milwaukee (5.42), Wisconsin. In Montana, no precipitation fell at Havre, setting a record low, and only 0.03 inch fell at Glasgow, equaling the record low. Record-low precipitation also occurred at Williston, North Dakota (0.07). Total Precipitation and Percentage of Normal Precipitation maps for December are on page 7. A map showing fall (September through November 1987) highlights is on page 18. January through March 1988 outlook maps for both temperature and precipitation are on page 19.

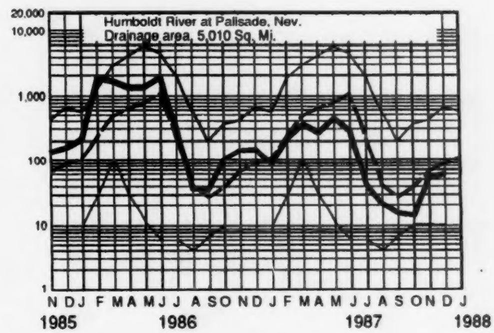
Precipitation for December 1986 through November 1987 was highly variable on a seasonal basis (see maps on pages 16-17) with the overall result that streamflow was in the normal to below-normal range in much of the United States and southern Canada for calendar year 1987 (map on page 18). About 87 percent of the 191 sites reporting for 1987 had flows in the normal to below-normal range compared with about 68 percent in those ranges for calendar year 1986. The combined flow of the "Big 3" averaged 927,400 cfs for 1987, in the normal range but about 8 percent below median. Flow of the St. Lawrence River at Cornwall, Ontario, averaged an above-normal 292,300 cfs, about 13 percent above median, but was well below the record high of last year (315,700 cfs). Flow of the Mississippi River at Vicksburg, Mississippi, averaged a normal 505,500 cfs, about 10 percent below median. Flow of the Columbia River at The Dalles, Oregon, averaged a below-normal 129,600 cfs, about 32 percent below median, but was well above the record low for adjusted data (1928 to date), 111,400 cfs in 1977. (See pages 14-15 for additional comparative data on 1987 calendar year streamflow.)

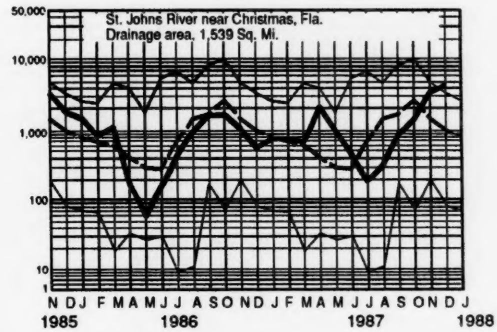
MONTHLY MEAN DISCHARGE OF SELECTED STREAMS

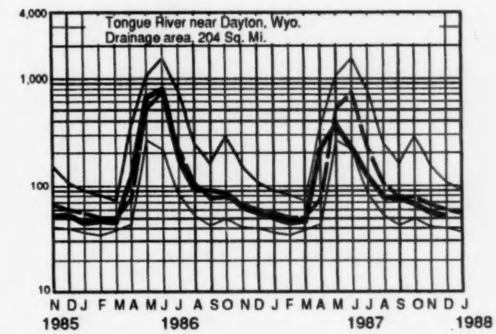
Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period.

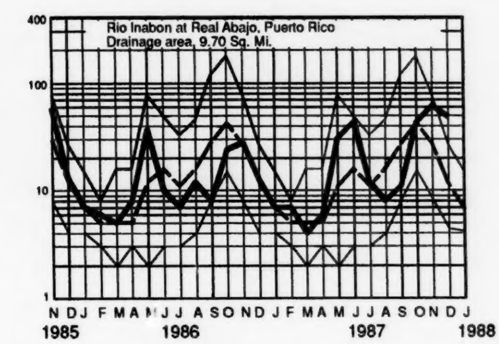
DISCHARGE, IN CUBIC FEET PER SECOND

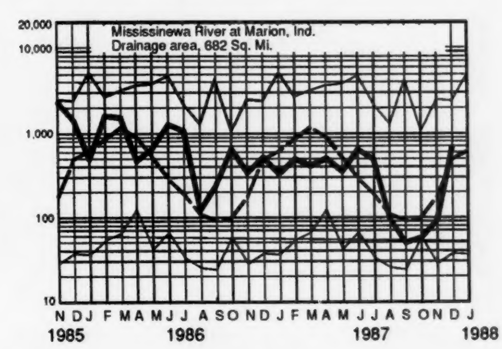


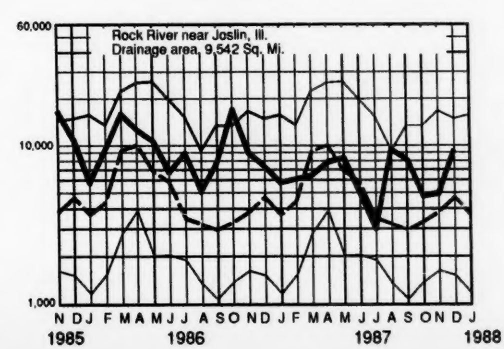


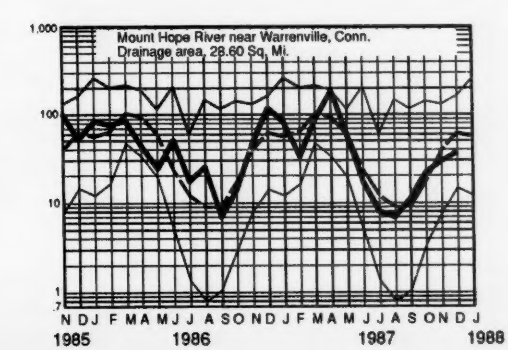






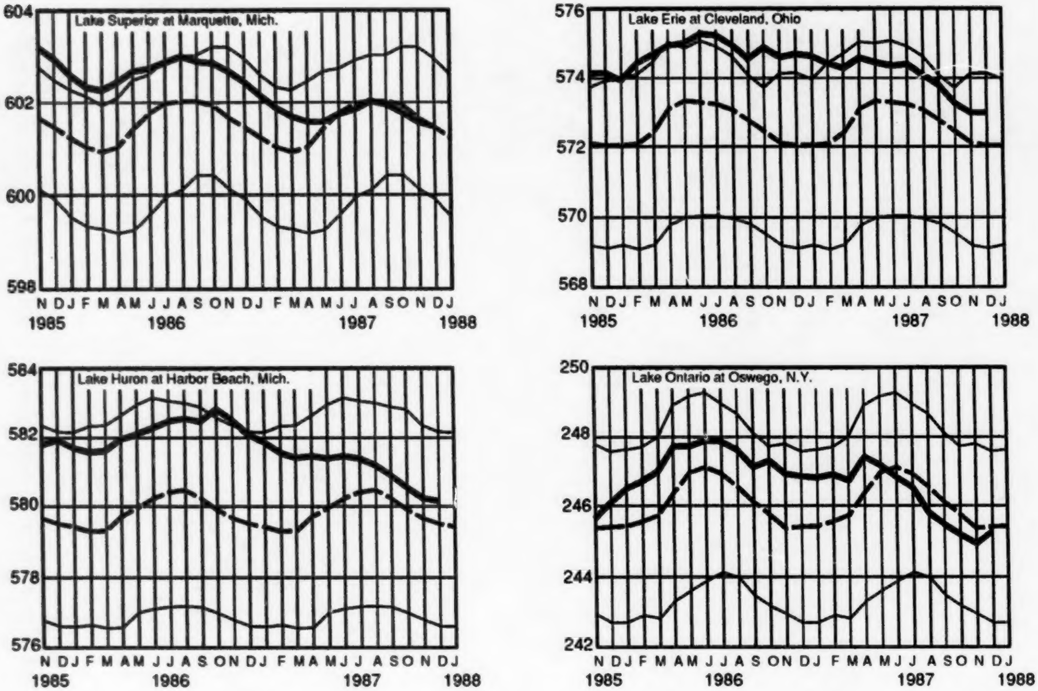






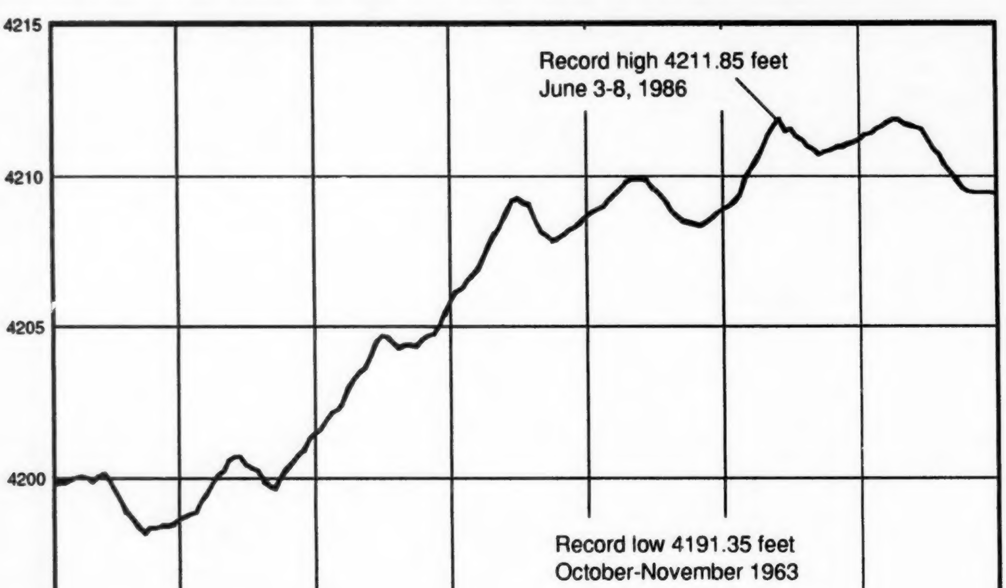
GREAT LAKES ELEVATIONS

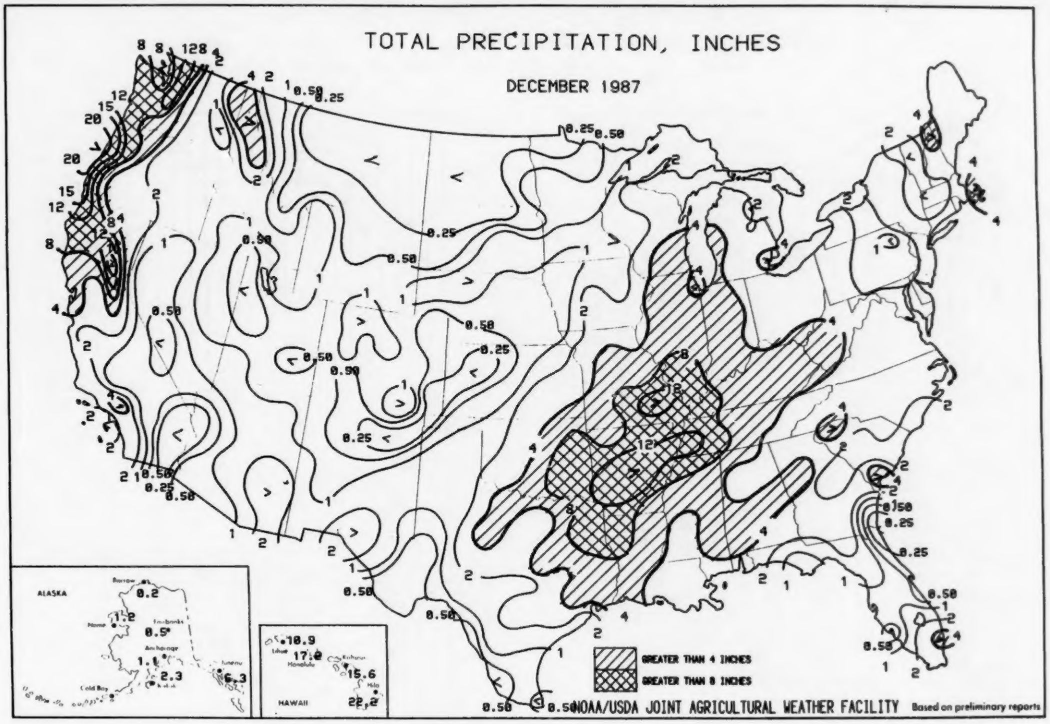
Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period. Data from National Ocean Service.

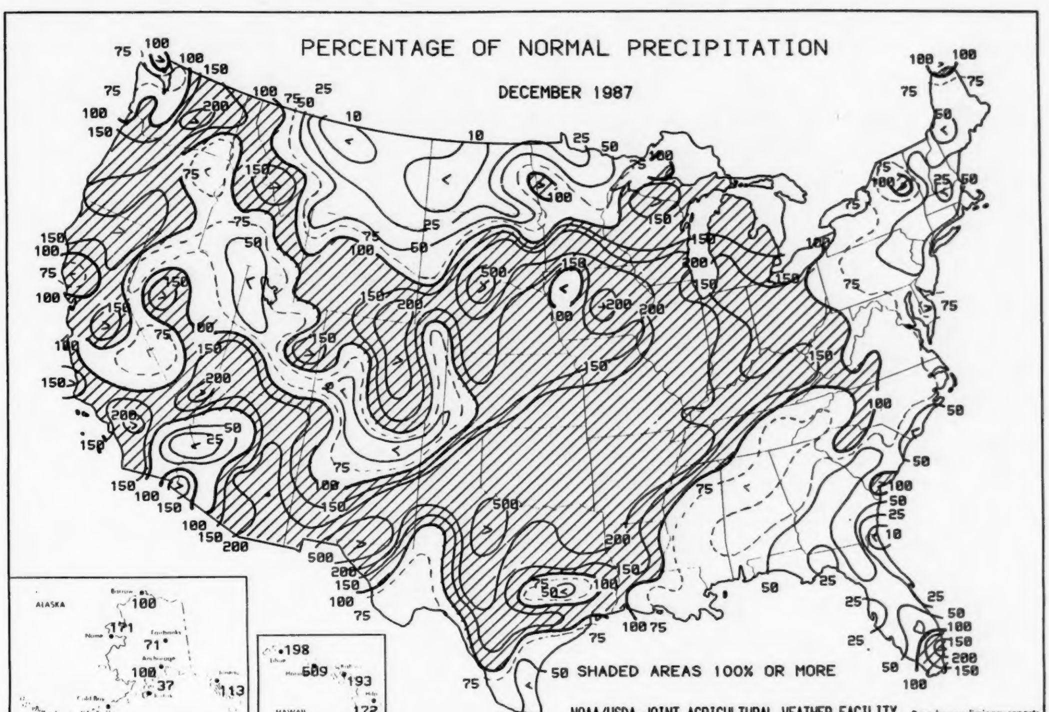


ELEVATION, IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM OF 1929

Fluctuations of Great Salt Lake, February 1981 through December 1987



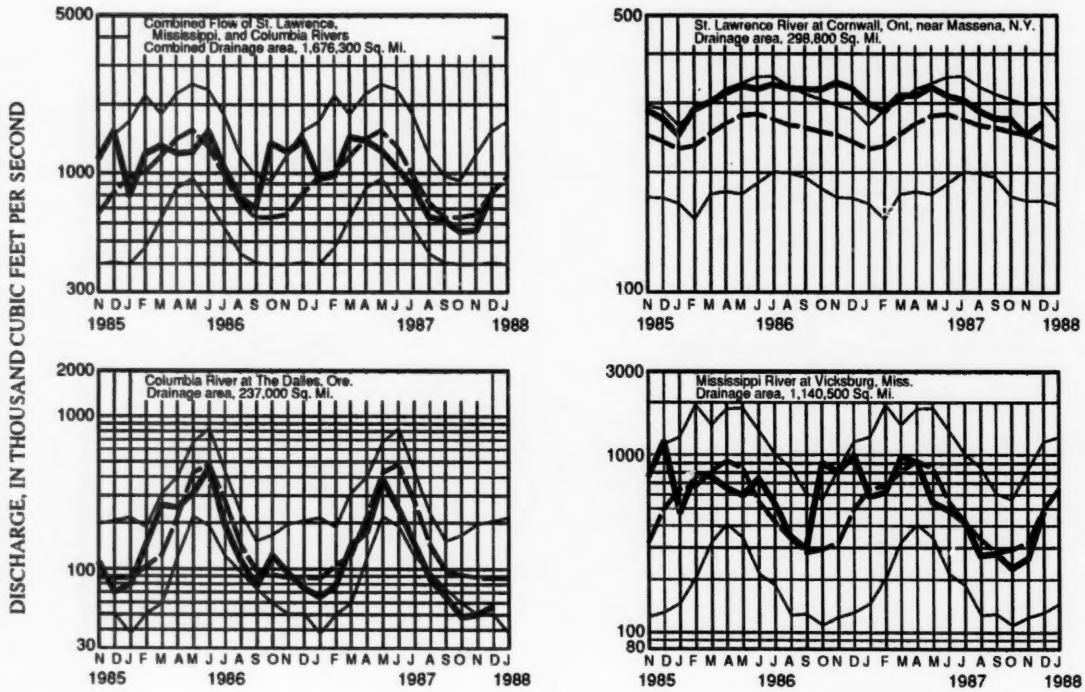




(From *Weekly Weather and Crop Bulletin* prepared and published by the NOAA/USDA Joint Agricultural Weather Facility)

HYDROGRAPHS FOR THE "BIG THREE" RIVERS

Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period.



Provisional data; subject to revision

DISSOLVED SOLIDS AND WATER TEMPERATURES, FOR DECEMBER 1987, AT DOWNSTREAM SITES ON FIVE LARGE RIVERS

Station number	Station name	December data of following calendar years	Stream discharge during month Mean (cfs)	Dissolved-solids concentration[a] Mini-mum (mg/L)	Mini-mum (mg/L)	Dissolved-solids discharge[a] (tons per day) Mean	Mini-mum	Mini-mum	Water temperature[b] Mean in °C	Mini-mum, in °C	Mini-mum, in °C
01463500	Delaware River at Trenton, N.J.	1987	12,600	78	105	3,100	2,120	7,410	4.5	0.0	7.5
	(Morrisville, Pa.)	1944-86	13,210	62	138	---	631	20,500	---	0.0	12.0
		(Extreme yr)		(1983)	(1980)		(1964)	(1973)			
			[c]11,650								
07289000	Mississippi River at	1987	480,500	201	296	335,200	274,100	533,700	8.5	7.0	12.0
	Vicksburg, Miss.	1975-86	751,500	153	295	421,000	131,000	712,800	7.5	0.0	13.0
		(Extreme yr)		(1978)	(1980)		(1976)	(1985)			
			[c]495,500								
03612500	Ohio River at lock and dam 53,	1987	192,000	244	353	---	77,100	118,000	---	5.0	11.5
	near Grand Chain, Ill. (stream-	1954-86	333,800	138	362	---	21,300	469,000	---	0.0	14.0
	flow station at Metropolis, Ill.)	(Extreme yr)		(1962)	(1969)		(1980)	(1977)			
			[c]286,000								
06934500	Missouri River at Hermann,	1987	100,600	283	453	92,800	47,500	147,000	3.5	2.0	5.0
	Mo. (60 miles west of	1975-86	79,620	222	770	79,340	34,600	237,000	3.5	0.0	14.0
	St. Louis, Mo.)	(Extreme yr)		(1982)	(1978)		(1980)	(1982)			
			[c]40,520								
14128910	Columbia River at Warrendale,	1987	143,000	103	120	44,000	30,900	54,900	8.0	4.5	10.0
	Oreg. (streamflow station at	1975-86	157,600	82	128	45,900	22,800	77,300	6.5	0.5	10.5
	The Dalles, Oreg.)	(Extreme yr)		(1975)	(1984)		(1978)	(1980)			
			[c]87,495								

[a]Dissolved-solids concentrations, when not analyzed directly, are calculated on basis of measurements of specific conductance.
[b]To convert °C to °F: $[(1.8 \times {}^{\circ}C) + 32] = {}^{\circ}F$.
[c]Median of monthly values for 30-year reference period, water years 1951-80, for comparison with data for current month.

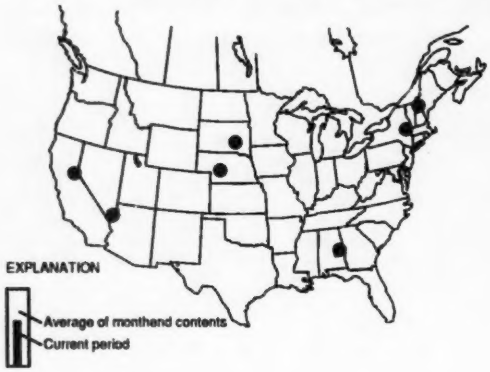
Provisional data; subject to revision

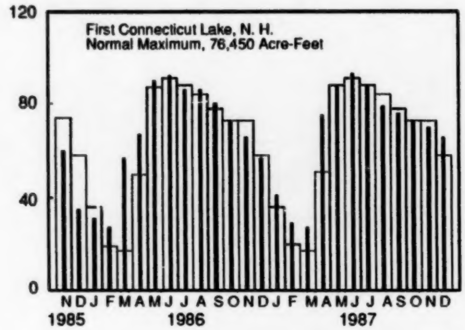
FLOW OF LARGE RIVERS DURING DECEMBER 1987

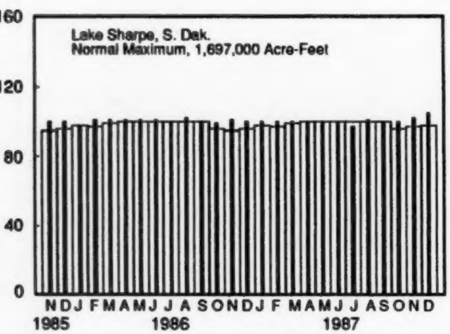
Station number	Stream and place of determination	Drainage area (square miles)	Average discharge through September 1980 (cubic feet per second)	December 1987					
				Monthly mean discharge (cubic feet per second)	Percent of median monthly discharge, 1951—80	Change in discharge from previous month (percent)	Discharge near end of month		
							Cubic feet per second	Million gallons per day	Date
01014000	St. John River below Fish River at Fort Kent, Maine	5,690	9,647	6,966	142	−2	3,600	2,330	31
01318500	Hudson River at Hadley, N.Y.	1,664	2,909	2,870	116	−8	1,540	995	31
01357500	Mohawk River at Cohoes, N.Y.	3,456	5,734	5,600	107	−3	3,500	2,260	31
01463500	Delaware River at Trenton, N.J.	6,780	11,750	12,600	108	+21	7,810	5,047	31
01570500	Susquehanna River at Harrisburg, Pa.	24,100	34,530	37,000	108	+77	31,900	20,620	28
01646500	Potomac River near Washington, D.C.	11,560	[1]11,490	[1]12,160	122	+105	15,700	10,150	31
02105500	Cape Fear River at William O. Huske Lock near Tarheel, N.C.	4,810	5,005	1,580	41	+24	.....	.....	...
02131000	Pee Dee River at Peedee, S.C.	8,830	9,851	9,430	126	+73	16,000	10,300	31
02226000	Altamaha River at Doctortown, Ga.	13,600	13,880	2,741	35	+30	3,320	2,145	30
02320500	Suwannee River at Branford, Fl.	7,880	6,987	2,700	84	−9	2,560	1,650	31
02358000	Apalachicola River at Chattahoochee, Fl.	17,200	22,570	8,680	51	+31	.....	.....	...
02467000	Tombigbee River at Demopolis lock and dam near Coatopa, Ala.	15,400	23,300	6,550	32	+184	18,600	12,020	31
02489500	Pearl River near Bogalusa, La.	6,630	9,768	3,119	57	+12	3,860	2,494	31
03049500	Allegheny River at Natrona, Pa.	11,410	[1]19,480	[1]32,920	126	+148	45,800	29,600	22
03085000	Monongahela River at Braddock, Pa.	7,337	[1]12,510	[1]16,700	113	+282	22,400	14,480	21
03193000	Kanawha River at Kanawha Falls, W.Va.	8,367	12,590	12,460	91	+195	29,500	19,070	29
03234500	Scioto River at Higby, Ohio	5,131	4,547	1,031	25	+18	1,800	1,160	31
03294500	Ohio River at Louisville, Ky.[2]	91,170	11,600	121,900	94	+167	201,600	130,300	31
03377500	Wabash River at Mount Carmel, Ill.	28,635	27,220	24,200	105	+404	53,200	34,380	31
03469000	French Broad River below Douglas Dam, Tenn.	4,543	6,798	3,180	49	+57	.....	.....	...
04084500	Fox River at Rapide Croche Dam, near Wrightstown, Wis.[2]	,150	4,163	5,302	148	+32	4,188	2,706	31
04264331	St. Lawrence River at Cornwall, Ontario-near Massena, N.Y.[3]	298,800	242,700	267,000	112	+8	270,000	175,000	31
02NG001	St. Maurice River at Grand Mere, Quebec	16,300	25,150	18,100	136	−22	20,300	13,120	30
05082500	Red River of the North at Grand Forks, N.Dak.	30,100	2,551	600	52	−11	590	381	30
05133500	Rainy River at Manitou Rapids, Minn.	19,400	11,830	7,200	73	−10	7,300	4,720	23
05330000	Minnesota River near Jordan, Minn.	16,200	3,402	823	126	+42	800	520	31
05331000	Mississippi River at St. Paul, Minn.	36,800	[1]10,610	4,672	96	−6	3,900	2,520	31
05365500	Chippewa River at Chippewa Falls, Wis.	5,600	5,100	3,765	120	+20	3,130	2,022	31
05407000	Wisconsin River at Muscoda, Wis.	10,300	8,617	7,787	120	+30	8,101	5,235	31
05446500	Rock River near Joslin, Ill.	9,551	5,873	9,340	199	+88	10,600	6,850	31
05474500	Mississippi River at Keokuk, Iowa	119,000	62,620	60,600	166	+46	53,100	34,320	31
06214500	Yellowstone River at Billings, Mont.	11,796	7,038	2,289	75	−12	2,020	1,305	31
06934500	Missouri River at Hermann, Mo.	524,200	79,490	94,340	233	+52	130,000	84,000	31
07289000	Mississippi River at Vicksburg, Miss.[4]	1,140,500	576,600	480,500	97	+83	799,000	516,400	28
07331000	Washita River near Dickson, Okla.	7,202	1,368	4,920	1,370	+270	5,020	3,244	31
08276500	Rio Grande below Taos Junction Bridge, near Taos, N.Mex.	9,730	725	591	138	+4	590	381	31
09315000	Green River at Green River, Utah	44,850	6,298	3,311	138	−16	....	....	..
11425500	Sacramento River at Verona, Calif.	21,257	18,820	14,780	71	+111	15,640	10,108	31
13269000	Snake River at Weiser, Idaho	69,200	18,050	11,200	72	−6	10,600	6,850	31
13317000	Salmon River at White Bird, Idaho	13,550	11,250	3,080	67	−4	3,760	2,430	30
13342500	Clearwater River at Spalding, Idaho	9,570	15,480	2,610	41	+149	2,690	1,738	31
14105700	Columbia River at The Dalles, Oreg.[5]	237,000	[1]193,100	[1]57,100	65	+14	144,500	93,390	28
14191000	Willamette River at Salem, Oreg.	7,280	[1]23,510	[1]34,200	78	+601	20,200	13,060	28
15515500	Tanana River at Nenana, Alaska	25,600	23,460	7,877	117	−31	7,200	4,650	31
08MF005	Fraser River at Hope, British Columbia.	83,800	96,290	28,780	65	−33	25,350	16,380	30

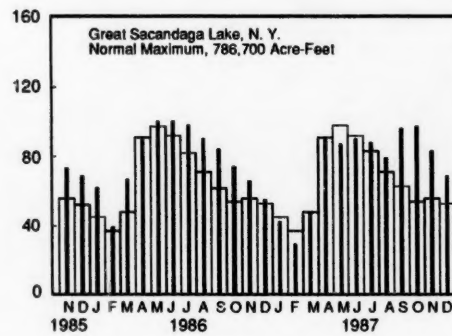
[1]Adjusted.
[2]Records furnished by Corps of Engineers.
[3]Records furnished by Buffalo District, Corps of Engineers, through International St. Lawrence River Board of Control. Discharges shown are considered to be the same as discharge at Ogdensburg, N.Y. when adjusted for storage in Lake St. Lawrence.
[4]Records of daily discharge computed jointly by Corps of Engineers and Geological Survey.
[5]Discharge determined from information furnished by Bureau of Reclamation, Corps of Engineers, and Geological Survey.

USABLE CONTENTS OF SELECTED RESERVOIRS AND RESERVOIR SYSTEMS

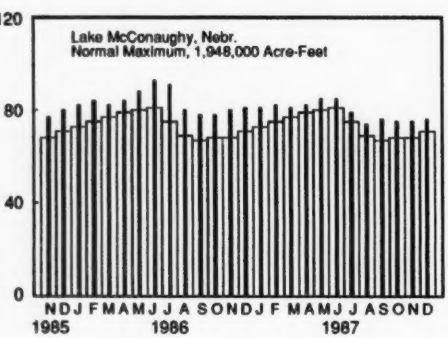


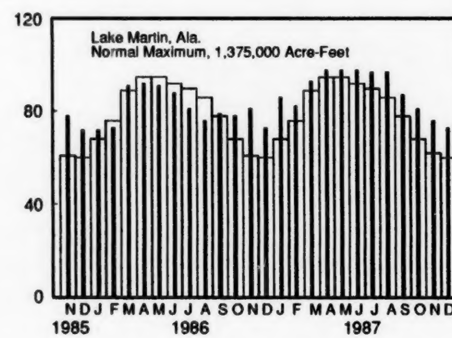


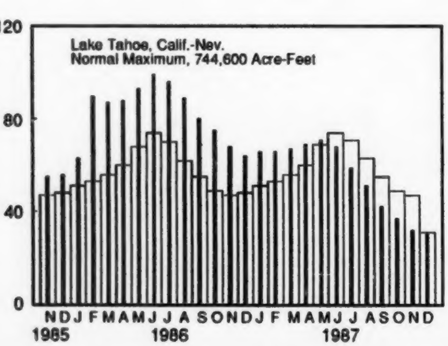


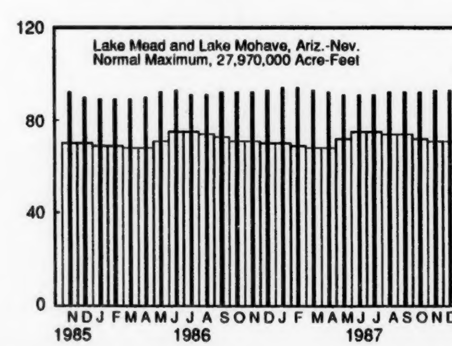


PERCENT OF NORMAL MAXIMUM









Provisional data; subject to revision

USABLE CONTENTS OF SELECTED RESERVOIRS NEAR END OF DECEMBER 1987

[Contents are expressed in percent of reservoir capacity. The usable storage capacity of each reservoir is shown in the column headed "Normal maximum."]

Reservoir Principal uses: F-Flood control I-Irrigation M-Municipal P-Power R-Recreation W-Industrial	Percent of normal maximum: End of Dec. 1987	End of Dec. 1986	Average for end of Dec.	End of Nov. 1987	Normal maximum[a] (acre-feet)
NOVA SCOTIA					
Rossignol, Mulgrave, Falls Lake, St. Margaret's Bay, Black, and Ponhook Reservoirs(P)	53	42	50	39	[b]226,300
QUEBEC					
Allard (P)	22	83	58	24	280,600
Gouin (P)	48	89	66	48	6,954,000
MAINE					
Seven reservoir systems (MP)	54	55	57	49	4,107,000
NEW HAMPSHIRE					
First Connecticut Lake (P)	66	57	58	70	76,450
Lake Francis (FPR)	75	75	70	80	99,310
Lake Winnipesaukee (PR)	59	75	62	63	165,700
VERMONT					
Harriman (P)	67	68	60	72	116,200
Somerset (P)	80	85	68	88	57,390
MASSACHUSETTS					
Cobble Mountain and Borden Brook (MP)	79	78	72	79	77,920
NEW YORK					
Great Sacandaga Lake (FPR)	69	55	53	83	786,700
Indian Lake (FMP)	59	76	62	53	103,300
New York City reservoir system (MW)	87	89	82	87	1,680,000
NEW JERSEY					
Wanaque (M)	83	93	72	79	85,100
PENNSYLVANIA					
Allegheny (FPR)	31	32	34	35	1,180,000
Pymatuning (FMR)	88	73	81	94	188,000
Raystown Lake (FR)	67	68	56	68	761,900
Lake Wallenpaupack (PR)	57	75	57	44	157,800
MARYLAND					
Baltimore municipal system (M)	86	66	84	85	261,900
NORTH CAROLINA					
Bridgewater (Lake James) (P)	92	95	78	92	288,800
Narrows (Badin Lake) (P)	87	85	93	92	128,900
High Rock Lake (P)	54	79	60	46	234,800
SOUTH CAROLINA					
Lake Murray (P)	75	85	62	77	1,614,000
Lakes Marion and Moultrie (P)	64	59	61	75	1,862,000
SOUTH CAROLINA—GEORGIA					
Clark Hill (FP)	35	52	53	37	1,730,000
GEORGIA					
Burton (PR)	81	89	54	87	104,000
Sinclair (MPR)	88	88	75	88	214,000
Lake Sidney Lanier (FMPR)	38	42	50	38	1,686,000
ALABAMA					
Lake Martin (P)	73	73	60	76	1,375,000
TENNESSEE VALLEY					
Clinch Projects: Norris and Melton Hill Lakes (FPR)	28	41	31	22	2,293,000
Douglas Lake (FPR)	15	16	11	13	1,394,000
Hiwassee Projects: Chatuge, Nottely, Hiwassee, Apalachia, Blue Ridge, Ocoee 3, and Parksville Lakes (FPR)	67	53	39	52	1,012,000
Holston Projects: South Holston, Watauga, Boone, Fort Patrick Henry, and Cherokee Lakes (FPR)	36	46	33	37	2,880,000
Little Tennessee Projects: Nantahala, Thorpe, Fontana, and Chilhowee Lakes (FPR)	40	48	39	41	1,478,000
WISCONSIN					
Chippewa and Flambeau (PR)	91	70	63	93	365,000
Wisconsin River (21 reservoirs) (PR)	67	65	55	61	399,000
MINNESOTA					
Mississippi River headwater system (FMR)	29	31	23	32	1,640,000
NORTH DAKOTA					
Lake Sakakawea (Garrison) (FIPR)	80	90	85	83	22,700,000
SOUTH DAKOTA					
Angostura (I)	68	88	71	66	130,768
Belle Fourche (I)	64	63	44	60	185,200
Lake Francis Case (FIP)	57	54	59	54	4,589,000
Lake Oahe (FIP)	82	82	. . .	81	22,240,000
Lake Sharpe (FIP)	105	100	98	102	1,697,000
Lewis and Clark Lake (FIP)	98	91	101	100	432,000

Reservoir Principal uses: F-Flood control I-Irrigation M-Municipal P-Power R-Recreation W-Industrial	Percent of Normal maximum: End of Dec. 1987	End of Dec. 1986	Average for end of Dec.	End of Nov. 1987	Normal maximum[a] (acre-feet)
NEBRASKA					
Lake McConaughy (IP)	76	81	71	75	1,948,000
OKLAHOMA					
Eufaula (FRP)	136	103	85	96	2,378,000
Keystone (FPR)	117	103	92	86	661,000
Tenkiller Ferry (FPR)	154	106	93	116	628,200
Lake Altus (FIMR)	90	100	48	86	133,000
Lake O'The Cherokees (FPR)	118	96	81	62	1,492,000
OKLAHOMA—TEXAS					
Lake Texoma (FMPRW)	. . .	99	. . .	88	2,722,000
TEXAS					
Bridgeport (IMW)	81	92	47	82	386,400
Canyon (FMR)	89	112	79	85	385,600
International Amistad (FIMPW)	100	82	84	98	3,497,000
International Falcon (FIMPW)	104	63	75	104	2,668,000
Livingston (IMW)	102	104	88	98	1,788,000
Possum Kingdom (IMPRW)	66	96	97	64	570,200
Red Bluff (PI)	71	77	29	70	307,000
Toledo Bend (P)	85	95	84	79	4,472,000
Twin Buttes (FIM)	80	45	30	78	177,800
Lake Kemp (IMW)	86	102	85	85	268,000
Lake Meredith (FWM)	36	29	37	37	796,900
Lake Travis (FIMPRW)	134	110	79	88	1,144,000
MONTANA					
Canyon Ferry (FIMPR)	75	82	85	77	2,043,000
Fort Peck (FPR)	81	85	84	83	18,910,000
Hungry Horse (FIPR)	59	76	76	63	3,451,000
WASHINGTON					
Ross (PR)	52	76	69	61	1,052,000
Franklin D. Roosevelt Lake (IP)	77	94	94	94	5,022,000
Lake Chelan (PR)	46	54	55	58	676,100
Lake Cushman (PR)	62	46	82	60	359,500
Lake Merwin (P)	101	100	96	99	245,600
IDAHO					
Boise River (4 reservoirs) (FIP)	30	54	58	28	1,235,000
Coeur d'Alene Lake (P)	24	35	55	43	238,500
Pend Oreille Lake (FP)	33	35	49	29	1,561,000
IDAHO—WYOMING					
Upper Snake River (8 reservoirs) (MP)	43	56	61	34	4,401,000
WYOMING					
Boysen (FIP)	79	82	75	84	802,000
Buffalo Bill (IP)	45	64	68	45	421,300
Keyhole (F)	40	34	42	40	193,800
Pathfinder, Seminoe, Alcova, Kortes, Glendo, and Guernsey Reservoirs (I)	58	68	49	57	3,056,000
COLORADO					
John Martin (FIR)	74	79	18	70	364,400
Taylor Park (IR)	71	72	55	71	106,200
Colorado-Big Thompson project (I)	69	82	57	69	730,300
COLORADO RIVER STORAGE PROJECT					
Lake Powell; Flaming Gorge, Fontenelle, Navajo, and Blue Mesa Reservoirs (IFPR)	85	88	. . .	89	31,620,000
UTAH—IDAHO					
Bear Lake (IPR)	70	75	58	70	1,421,000
CALIFORNIA					
Folsom (FIP)	30	48	54	26	1,000,000
Hetch Hetchy (MP)	46	42	37	51	360,400
Isabella (FIR)	25	43	26	25	568,100
Pine Flat (FI)	19	58	47	16	1,001,000
Clair Engle Lake (Lewiston) (P)	67	73	73	61	2,438,000
Lake Almanor (P)	71	69	50	77	1,036,000
Lake Berryessa (FIMW)	72	83	79	62	1,600,000
Millerton Lake (FI)	42	31	54	35	503,200
Shasta Lake (FIPR)	67	68	68	53	4,377,000
CALIFORNIA—NEVADA					
Lake Tahoe (IPR)	31	64	48	32	744,600
NEVADA					
Rye Patch (I)	30	69	57	30	194,300
ARIZONA—NEVADA					
Lake Mead and Lake Mohave (FIMP)	93	93	71	93	27,970,000
ARIZONA					
San Carlos (IP)	55	77	23	54	935,100
Salt and Verde River system (IMPR)	80	84	41	80	2,019,100
NEW MEXICO					
Conchas (FIR)	91	96	79	91	330,100
Elephant Butte and Caballo (FIPR)	92	96	34	90	2,442,000

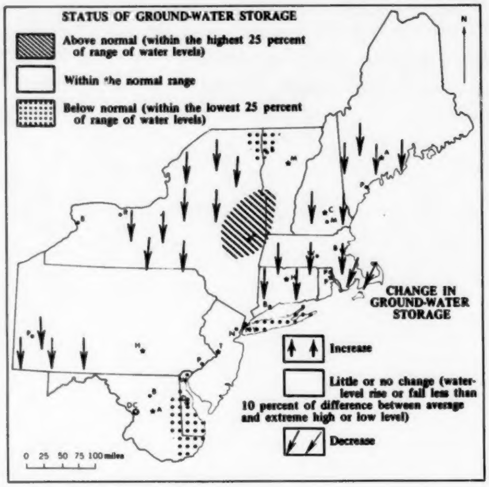
[a] 1 acre-foot = 0.04356 million cubic feet = 0.326 million gallons = 0.504 cubic feet per second day.
[b] Thousands of kilowatt-hours (the potential electric power that could be generated by the volume of water in storage).

GROUND-WATER CONDITIONS DURING DECEMBER 1987

Ground-water levels rose in many parts of the Northeast, including southern Maine, most of Massachusetts and Connecticut, and in central New York State. (See map.) Levels declined on Long Island, New York, and in southeastern Massachusetts. Levels remained near average seasonally in most of the region. Levels were above average in east-central New York State; and remained below average on Long Island, New York, and along the Maryland-Delaware Eastern Shore. The level in the observation well at Camden (near Dover) in central Delaware was the lowest for December of at least the past 20 years.

In the Southeastern States, ground-water levels declined during December in Kentucky and rose in West Virginia, Arkansas, and Mississippi. Net changes in levels were mixed in Virginia, North Carolina, and Georgia. Water levels were above long-term averages in Kentucky and North Carolina and below average in Arkansas. Levels were mixed with respect to average in West Virginia and Virginia. Despite a slight net rise during the month, a new low level for December occurred in the key well in Memphis in western Tennessee. The level in the observation well in Montgomery, Alabama, declined, reaching a new low for December.

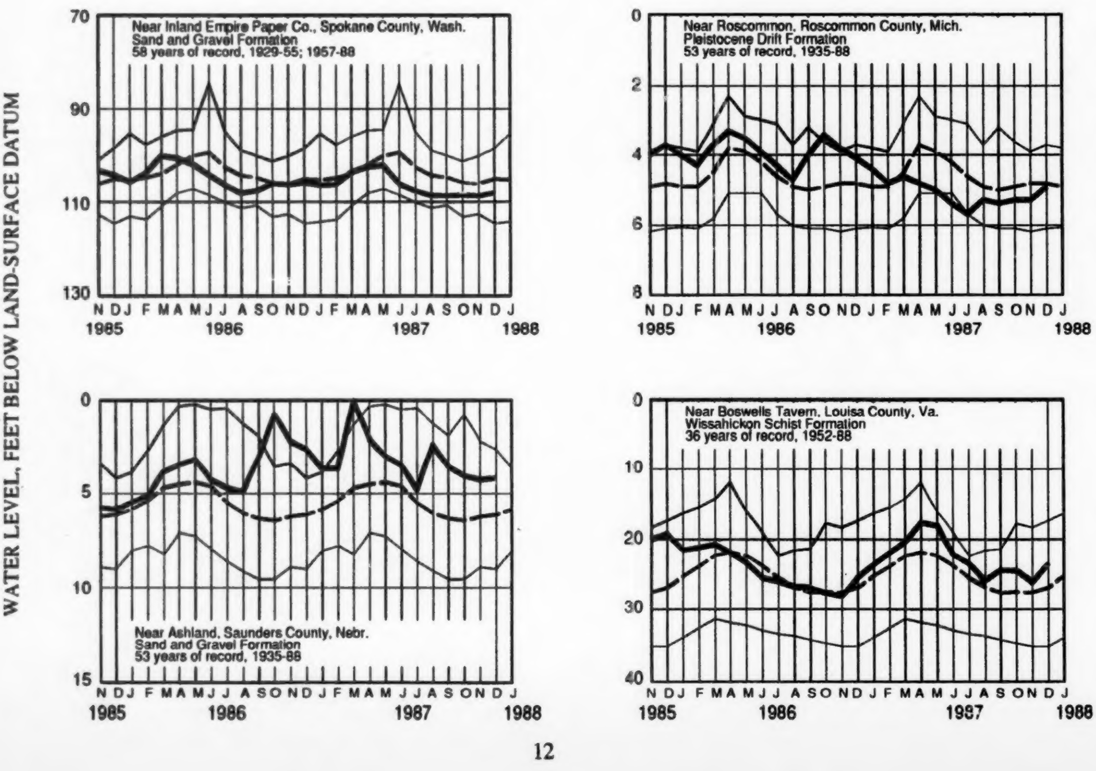
In the central and western Great Lakes States, ground-water levels rose only in Michigan. Net changes in levels were mixed in Minnesota, Wisconsin, and Iowa.



Map showing ground-water storage near end of December and change in ground-water storage from end of November to end of December.

MONTHEND GROUND-WATER LEVELS IN KEY WELLS

Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates average of monthly levels in previous years. Heavy line indicates level for current period.



Levels were mostly above average in Iowa, and mixed with respect to average in Minnesota and Michigan. A new high level for December was reached in the key well in Princeton in northwestern Illinois.

In the Western States, ground-water levels rose in Washington and New Mexico, and rose or held steady in Nevada. Levels mostly declined in Idaho, and mixed water-level changes occurred in North Dakota, Nebraska, Utah, Kansas, Arizona, and Texas. Levels were below long-term averages in Arizona, and mixed with respect to average in Washington, Idaho, North Dakota, Nebraska, Nevada, Utah, Kansas, New Mexico, and Texas. New December highs occurred in the Steptoe Valley well in Nevada, and in the Berrendo-Smith well in New Mexico. In the Las Vegas Valley key well in Nevada, a new December low was established despite a net rise of more than 2 feet during the month. Water levels declined to new December lows in the Kansas Agricultural Experiment Station key well in Colby, Kansas, and in the observation well at El Paso in western Texas.

Provisional data; subject to revision

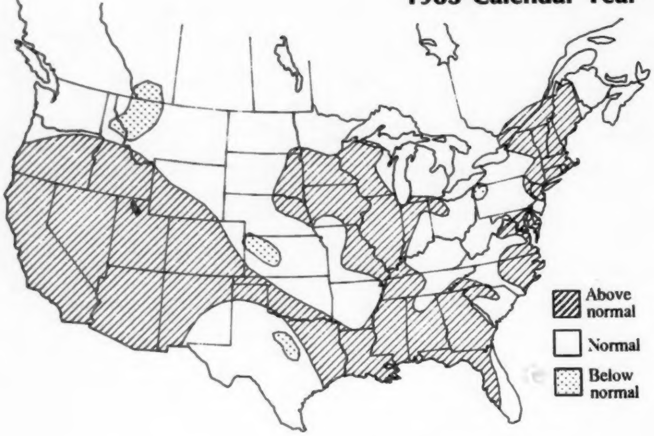
WATER LEVELS IN KEY OBSERVATION WELLS IN SOME REPRESENTATIVE AQUIFERS IN THE CONTERMINOUS UNITED STATES—DECEMBER 1987

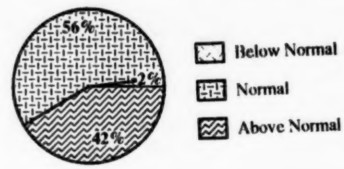
Aquifer and Location	Water level in feet with reference to land-surface datum	Departure from average in feet	Net change in water level in feet since: Last month	Net change in water level in feet since: Last year	Year records began	Remarks
Glacial drift at Hanska, south-central Minnesota.	−12.32	−3.99	+0.70	−6.62	1942	
Glacial drift at Roscommon in north-central part of Lower Peninsula, Michigan.	−4.90	−0.09	+0.45	−0.75	1935	
Glacial drift at Marion, Iowa........................	−2.65	+3.59	+1.72	−0.54	1941	
Glacial drift at Princeton in northwestern Illinois.	−5.9	+8.01	+1.25	+0.9	1943	December high.
Petersburg Granite, southeastern Piedmont near Fall Zone, Colonial Heights, Virginia.	−17.39	−1.45	+0.07	−0.72	1939	
Glacial outwash sand and gravel, Louisville, Kentucky (U.S. well no. 2).	−19.29	+5.91	−0.02	−1.06	1946	
500-foot sand aquifer near Memphis, Tennessee (U.S. well no. 2).	−106.49	−16.65	+0.19	−1.04	1941	December low.
Weathered granite, Mocksville area, Davie County, western Piedmont, North Carolina.	−18.5	+2.08	+0.81	+0.23	1932	
Sparta Sand in Pine Bluff industrial area, Arkansas.	−234.80	−27.44	+0.20	−6.90	1958	
Eutaw Formation in the City of Montgomery, Alabama (U.S. well no. 4).	−29.0	−7.3	−0.6	−2.5	1952	December low.
Limestone aquifer on Cockspur Island, Savannah area, Georgia (U.S. well no. 6).	−33.44	−6.51	+1.40	+0.16	1956	
Sand and gravel in Puget Trough, Tacoma, Washington.	−104.03	+5.56	+0.55	+2.01	1952	
Pleistocene glacial outwash gravel, North Pole, northern Idaho (U.S. well no. 3).	−465.9	−4.5	−0.7	−1.9	1929	
Snake River Group: Snake River Plain Aquifer, at Eden, Idaho (U.S. well no. 4).	−120.6	−3.1	−1.5	−1.3	1957	
Alluvial valley fill in Flowell area, Millard County, Utah (U.S. well no. 9).	−15.75	+10.89	+1.04	− 9.35	1929	
Alluvial sand and gravel, Platte River Valley, Ashland, Nebraska (U.S. well no. 6).	−4.25	+1.87	+0.05	−1.65	1935	
Alluvial valley fill in Steptoe Valley, Nevada....	−7.09	+5.63	+0.30	+0.29	1950	December high.
Pleistocene terrace deposits in Kansas River valley, at Lawrence, northeastern Kansas.	−20.10	+0.60	+0.04	−3.64	1953	
Alluvium and Paso Robles clay, sand, and gravel, Santa Maria, California	−128.18	+15.01	−0.58	−11.75	1957	
Valley fill, Elfrida area, Douglas, Arizona (U.S. well no. 15).	−102.5	−21.67	+0.8	+1.0	1951	
Hueco bolson, El Paso area, Texas................	−266.89	−19.17	−0.10	−0.57	1965	
Evangeline aquifer, Houston area, Texas.........	−302.22	−0.19	+4.28	+10.34	1965	

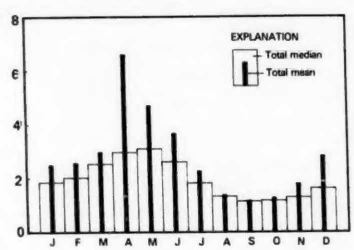
STREAMFLOW IN THE CONTERMINOUS UNITED STATES AND SOUTHERN CANADA FOR THE 1983-87 CALENDAR YEARS

The maps, pie charts, and bar graphs shown below depict streamflow conditions for the 1983-87 calendar years in the *conterminous United States and southern Canada.* The maps show the spatial distribution of flow range conditions; the pie charts visually condense the information shown by each map so that a comparison of the percent of area (4,683,467 square miles) in each flow range can be made readily; and the bar graphs show the time distribution of flow through the year -- both the total monthly mean and total monthly median, in millons of cubic feet per second (cfs), for all reporting stations for each month of the calendar year. (Note that the median flow indicates the *seasonal* distribution of flows through the year by months.) These illustrations show that there has been a general decline in streamflow from 1983 to 1987: 1983 and 1984 show only small areas of below-normal flow and total monthly means that are at or above the total median for each month; 1985 and 1986 show relatively large areas of below-normal flow and a general decrease in total mean flow, with some months below median; 1987 is dryer than any of the preceding 4 years and is the first calendar year since 1981 in which below-normal flow conditions have occurred in much of the conterminous United States and southern Canada. Flows have been in the normal range in from 42 percent (1987) to 67 percent (1984) of the conterminous United States and southern Canada despite fluctuating conditions for the 5 years. The greatest total flow (6,582,600 cfs) occurred during April 1983 and was about 122 percent above median. (October 1986 was also about 122 percent above median but total flow was only 2,596,300 cfs.) The lowest total flow (1,003,400 cfs) occurred during November 1987 and was about 14 percent below median. Flows during May 1987 and June 1987 were 24 percent and 22 percent below median, respectively, but flow during both months was greater than 2,000,000 cfs.

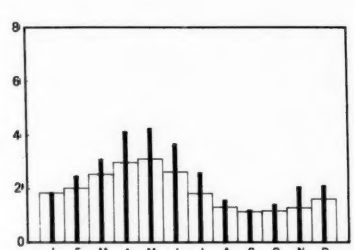
1983 Calendar Year



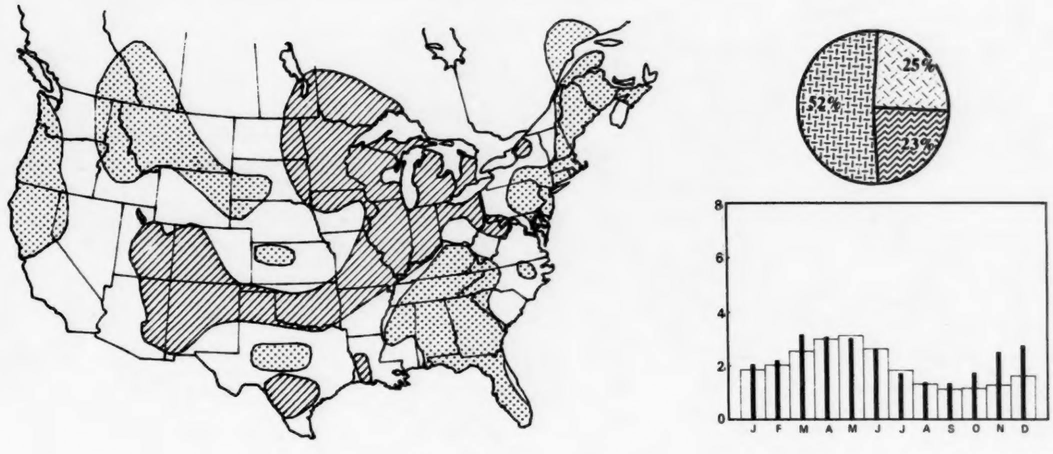




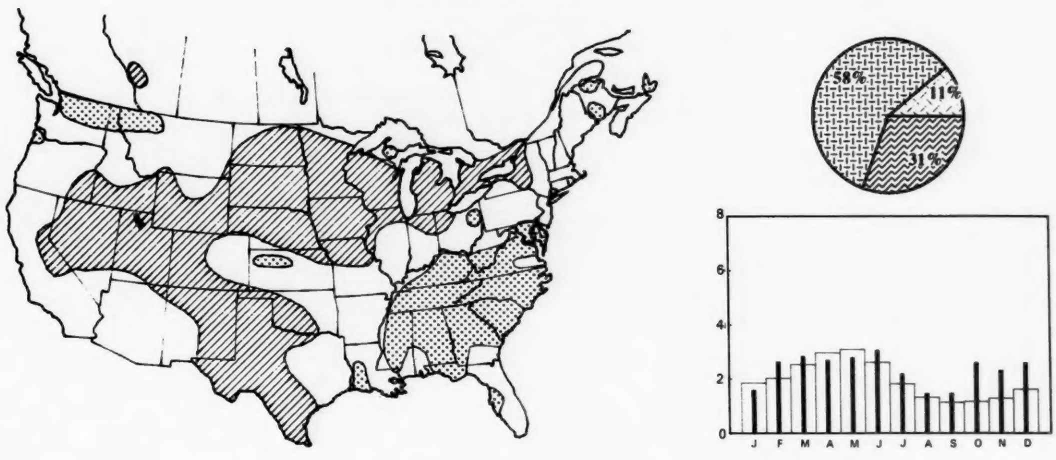
1984 Calendar Year



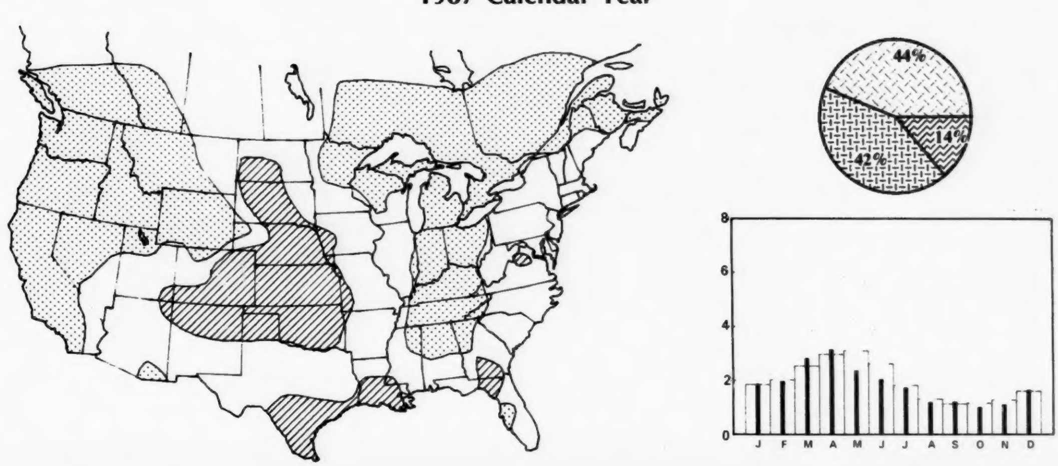
1985 Calendar Year

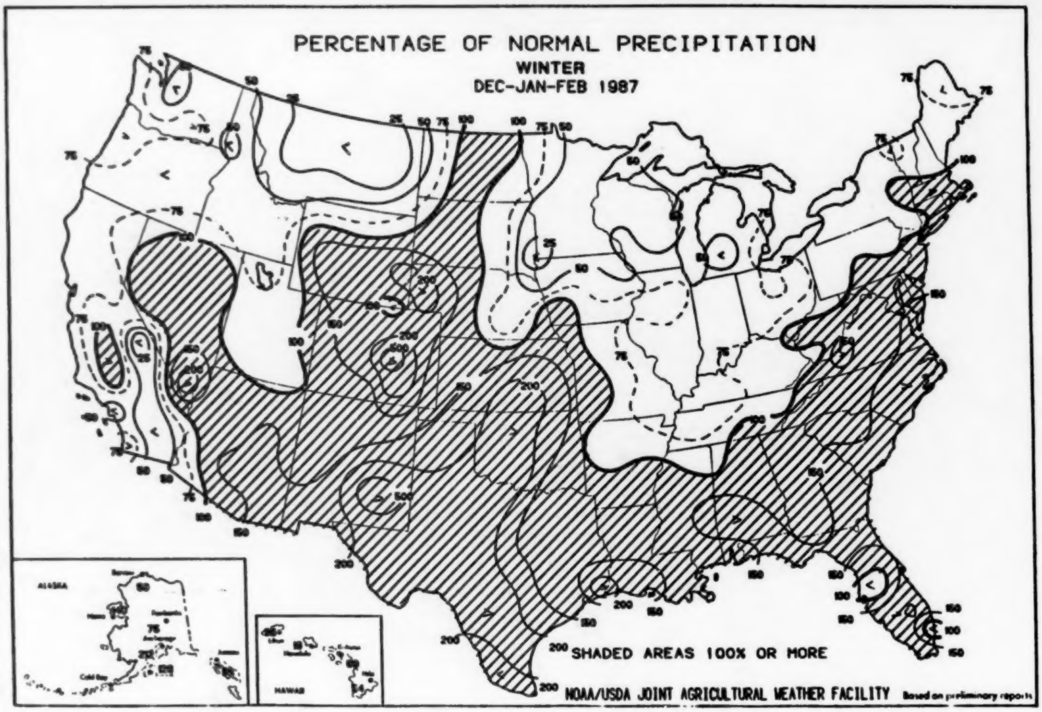


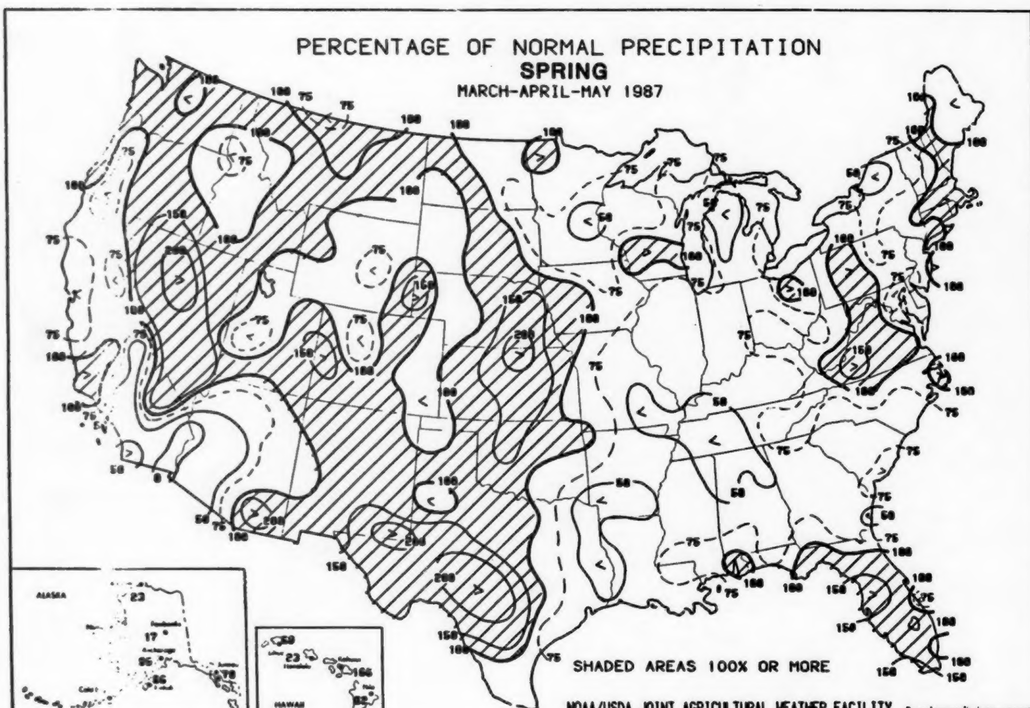
1986 Calendar Year



1987 Calendar Year







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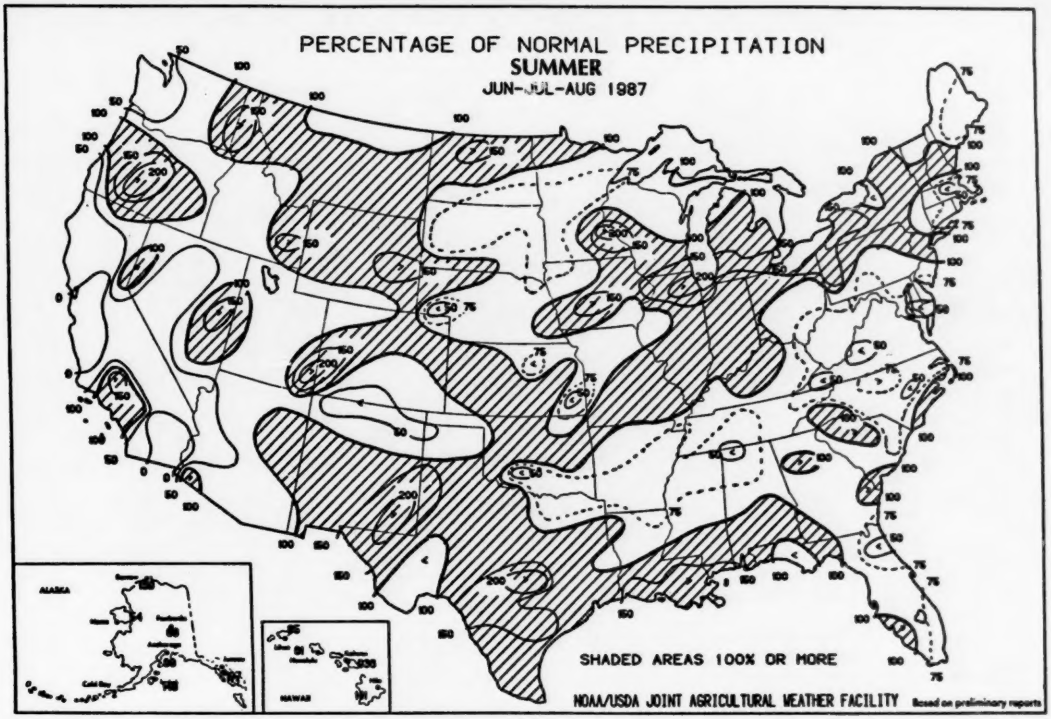

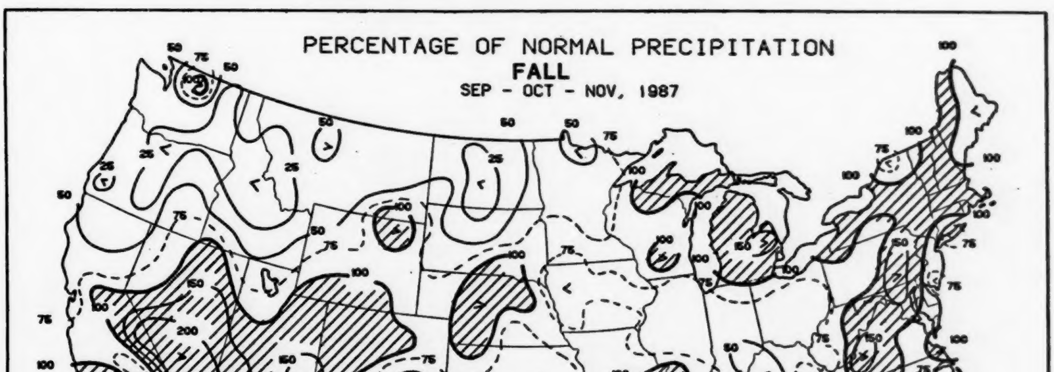

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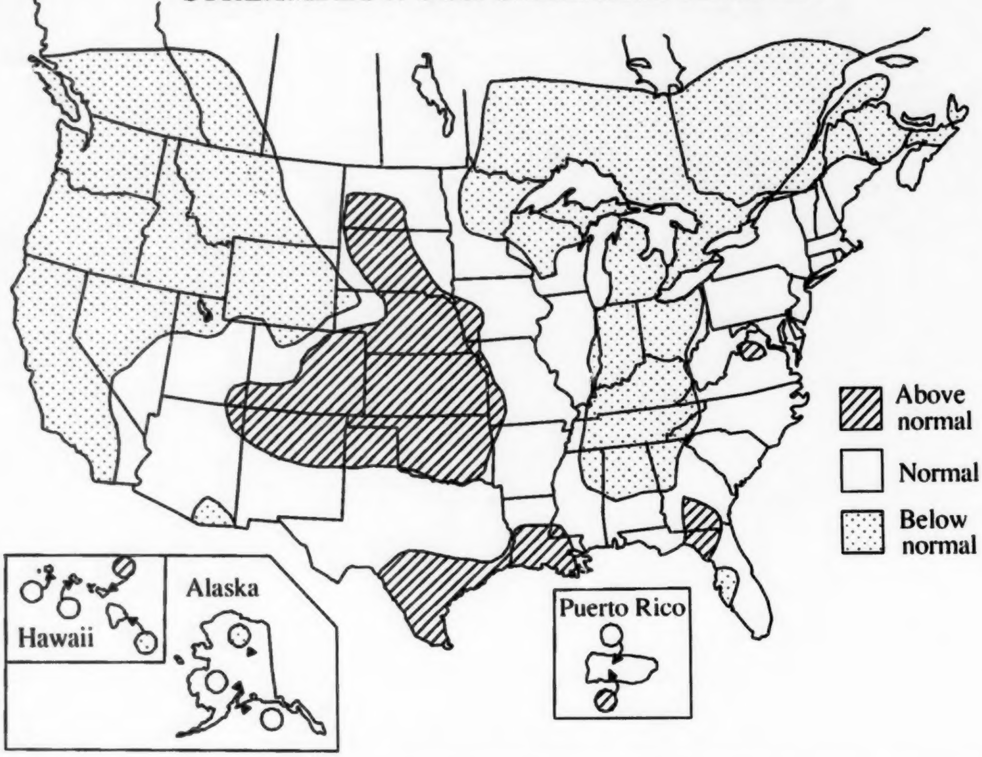
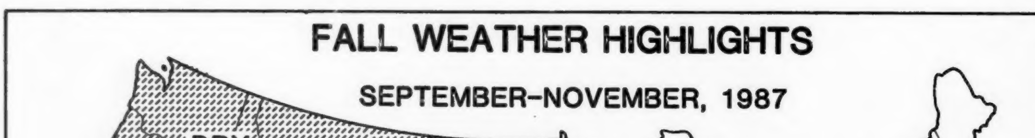
STREAMFLOW FOR CALENDAR YEAR 1987





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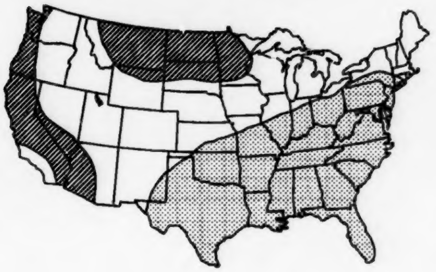
TEMPERATURE OUTLOOK FOR JANUARY THROUGH MARCH 1988



PRECIPITATION OUTLOOK FOR JANUARY THROUGH MARCH 1988

NATIONAL WATER CONDITIONS

DECEMBER 1987

Based on reports from the Canadian and U.S. Field offices; completed January 27, 1988

TECHNICAL STAFF
Thomas G. Ross, Editor
Carroll W. Saboe
John C. Kammerer
Allen Sinnott
Krishnaveni V. Sarma
Sharon A. Edmonds
Carole J. Marlow

COPY PREPARATION
Lois C. Fleshmon
Sharon L. Peterson
Aisha P.R. Law

GRAPHICS
Frances L. Buchanan
Carolyn L. Moss

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EXPLANATION OF DATA (Revised January 1988)

Cover map shows generalized pattern of streamflow for the month based on provisional data from 183 index gaging stations--18 in Canada, 163 in the United States, and 2 in the Commonwealth of Puerto Rico. Alaska, Hawaii, and Puerto Rico inset maps show streamflow only at the index gaging stations that are located near the point shown by the arrows. Classifications on map are based on comparison of streamflow for the current month at each index station with the flow for the same month in the 30-year reference period, 1951-80. Shorter reference periods are used for one Canadian index station, two Kansas index stations, one New York index station, and the Puerto Rico index stations because of the limited records available.

The *persistence/change map* shows where streamflow has persisted in the above- or below-normal range from last month to this month and also where streamflow is in the above- or below-normal range this month after being in a different range last month. The pie charts show percent of stations reporting discharges in each flow range for the conterminous United States, southern Canada, the two areas combined, and also the percent of area in each flow range for the conterminous United States and southern Canada. The bar graph shows total mean and total median flow for all reporting stations in the conterminous United States and southern Canada.

The comparative data are obtained by ranking the 30 flows for each month of the reference period in order of decreasing magnitude--the highest flow is given a ranking of 1 and the lowest flow is given a ranking of 30. Quartiles (25-percent points) are computed by averaging the 7th and 8th highest flows (upper quartile), 15th and 16th highest flows (middle quartile and median), and the 23rd and 24th highest flows (lower quartile). The upper and lower quartiles set off the highest 25 percent of flows and lowest 25 percent of flows, respectively, for the reference period. The median (middle quartile) is the middle value by definition. For the reference period, 50 percent of the flows are greater than the median, 50 percent are less than the median, 50 percent are between the upper and lower quartiles (in the normal range), 25 percent are greater than the upper quartile (above normal), and 25 percent are less than the lower quartile (below normal). Flow for the current month is then classified as: *above normal* if it is greater than the upper quartile, *in the normal range* if it is between the upper and lower quartiles, and *below normal* if it is less than the lower quartile. Change in flow from the previous month to the current month is classified as *seasonal* if the change is in the same direction as the change in the median. If the change is in the opposite direction of the change in the median, the change is classified as *contraseasonal* (opposite to the seasonal change). For example: at a particular index station, the January median is greater than the December median; if flow for the current January increased from December (the previous month), the increase is seasonal; if flow for the current January decreased from December, the decrease is contraseasonal.

Flood frequency analyses define the relation of flood peak magnitude to probability of occurrence or recurrence interval. *Probability of occurrence* is the chance that a given flood magnitude will be exceeded in any one year. *Recurrence interval* is the reciprocal of probability of occurrence and is the *average* number of years between occurrences. For example, a flood having a probability of occurrence of 0.01 (1 percent) has a recurrence interval of 100 years. *Recurrence intervals imply no regularity of occurrence*; a 100-year flood might be exceeded in consecutive years or it might not be exceeded in a 100-year period.

Statements about *ground-water levels* refer to conditions near the end of the month. The water level in each key observation well is compared with average level for the end of the month determined from the 30-year reference period, 1951-80, or from the entire past record for that well when only limited records are available. Comparative data for ground-water levels are obtained in the same manner as comparative data for streamflow. *Changes in ground-water levels*, unless described otherwise, are from the end of the previous month to the end of the current month.

Dissolved solids and temperature data for December are given for five stream-sampling sites that are part of the National Stream Quality Accounting Network (NASQAN). *Dissolved solids* are minerals dissolved in water and usually consist predominately of silica and ions of calcium, magnesium, sodium, potassium, carbonate, bicarbonate, sulfate, chloride, and nitrate. *Dissolved-solids discharge* represents the total daily amount of dissolved minerals carried by the stream. *Dissolved-solids concentrations* are generally higher during periods of low streamflow, but the highest dissolved-solids *discharges* occur during periods of high streamflow because the total quantities of water, and therefore total load of dissolved minerals, are so much greater than at times of low flow.

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UNITED STATES
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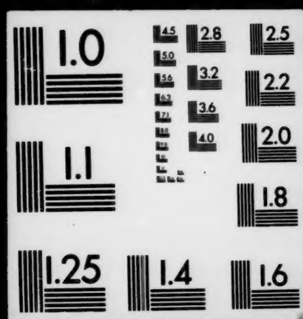
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